

## CLAIMS

1. ~~A wellbore fluid of the water-in-oil emulsion type comprising a discontinuous aqueous or brine phase, solids such as clays or weighting material and having a non-aqueous continuous liquid phase that comprises a polar organic liquid POL which exhibits a dielectric constant of at least about 5.0 and a Hildebrand Solubility Parameter of at least about  $17 \text{ (J cm}^{-3})^{1/2}$  so that the liquid phase exhibits an electrical conductivity of not less than  $10 \mu\text{S m}^{-1}$  at 1 kHz~~
2. A wellbore fluid as in claim 1, wherein the non-aqueous liquid phase further comprises a water immiscible organic liquid OL.
3. A wellbore fluid as in claim 2, wherein the non-aqueous liquid phase is comprised of 1 to 99% by volume of POL + 99 to 1% by volume OL, and more preferably of 5 to 95% by volume of POL and 95 to 5% by volume of OL.
4. A wellbore fluid as in any preceding claim, wherein the non-aqueous liquid phase further comprises a dissolved component (DC) selected from: water; inorganic salts wherein the anion(s) is (are) a conjugate base of an acid whose dissociation constant ( $\text{pK}_a$ ) in water at 298 °K is less than about 1.0, and the cation is ammonium ion or a metal ion which has an ionic radius of less than about 2/3 of the ionic radius of the pre-selected anion; quaternary ammonium salts or hydroxides; N-alkyl pyridinium salts or hydroxides; and organic bases exhibiting a  $\text{pK}_a$  in water at 298 °K of more than 10.0, and their salts.
5. A wellbore fluid as in claim 4, wherein the non-aqueous liquid phase comprises of about 0.1 % to about 50% by volume of the dissolved component DC.
6. A wellbore fluid as in claim 5, wherein the non-aqueous liquid phase comprises 1 to 98.5% by volume POL, 1 to 98.5% by volume OL and 0.5 to 50% by volume DC.
7. A wellbore fluid as in any of the preceding claims wherein the polar organic liquid POL is one or more selected from the class including alcohols, phenols, glycols, polyalkylene glycols, mono (alkyl or aryl) ethers of glycols, mono (alkyl or aryl) ethers of polyalkylene glycols, monoalkanoate esters of glycols, monoalkanoate

esters of polyalkylene glycols, ketones possessing also hydroxyl group(s), diketones.

8. A wellbore fluid as in any preceding claim, wherein the polar organic liquid POL component is selected from the class including:

- aliphatic and alicyclic alcohols of carbon numbers  $C_5-C_{10}$  such as *n*-pentanol, cyclohexanol, *n*-octanol, 2-ethylhexanol, and *n*-decanol;
- phenols such as orth-, meta-, or para-cresol;
- glycols such as 1,3-butane diol, 1,4-butane diol, 2-ethylhexane-1,3-diol;
- polyalkylene glycols such as polypropylene glycols of molecular weight above about 1000, polybutylene glycols, polytetrahydrofuran, polyalkylene glycols or copolymers of ethylene oxide and/or propylene oxide and/or butylene oxide initiated by any hydroxylic or amino-functional moiety wherein the polyalkylene glycol or copolymer is further characterised by exhibiting a cloud point (at 1% concentration in water) of less than about 10 °C;
- mono-alkyl or mono-aryl ethers of glycols or polyalkylene glycols such as ethylene glycol monobutyl ether, diethylene glycol monobutyl ether, dipropylene glycol monomethyl ether, tripropylene glycol monomethyl ether, propylene glycol monobutyl ether, dipropylene glycol monobutyl ether, tripropylene glycol monobutyl ether, propylene glycol phenyl ether, dipropylene glycol phenyl ether;
- diacetone alcohol (4-hydroxy-4-methyl-1,2-pentanone); acetylacetone; acetonylacetone.

9. A wellbore fluid as in any of claims 1 to 7, wherein the polar organic liquid POL is an aprotic solvent.

10. A wellbore fluid as in claim 4 wherein the inorganic salt comprises anions which are the conjugate base of an acid selected from the class including hydrochloric acid; hydrobromic acid; hydroiodic acid; thiocyanic acid; perchloric acid; nitric acid; permanganic acid; sulphuric acid; alkane sulphonic acids such as methane sulphonic acid and ethane sulphonic acid; arene sulphonic acids such as benzene sulphonic acid and naphthalene sulphonic acid; alkylaryl sulphonic acid such as toluene sulphonic acid; alkane and arene sulphonic acids substituted with electron-

withdrawing groups such as trifluoromethane sulphonic acid and 2,4-dinitrobenzene sulphonic acid; picric acid and trichloroacetic acid.

11. A wellbore fluid as in Claim 4 wherein the quaternary ammonium salts or hydroxides are the chlorides, bromides, iodides, methosulphates, ethosulphates or hydroxides of quaternary ammonium cations having alkyl and/or aryl and/or alkylaryl groups such that the total number of carbon atoms in all the groups combined with the nitrogen atom is in the range 8 to 60, and more preferably in the range 12 to 40.
12. A wellbore fluid as in Claim 4 wherein the organic base(s) exhibiting a  $pK_a$  in water of more than 10.0 is selected from the class including mono-, di-, and tri-alkylamines wherein the alkyl groups contain from 2 to 18 carbon atoms; alkylpiperidines; alkylpyrrolidines; N-alkylated ethyleneamines; and their salts.
13. A wellbore fluid of the water-in-oil emulsion type comprising a discontinuous aqueous or brine phase, solids such as clays or weighting material and having a non-aqueous continuous liquid phase that comprises that comprises from about 99.5% to about 50% by volume of a water immiscible organic liquid OL and about 0.5% to about 50% by volume of a dissolved component as claimed in 4 so that the liquid phase exhibits an electrical conductivity of not less than  $10 \mu S m^{-1}$  at 1 kHz
14. A wellbore fluid as in any preceding claims, wherein the water immiscible organic liquid OL is one, or a mixture of two or more, liquid(s) selected from the class including crude oil; hydrocarbon fractions refined from crude oil; synthetic hydrocarbons such as *n*-paraffins, alphaolefins, internal olefins, and polyalphaolefins; synthetic liquids such as dialkyl ethers, alkyl alkanoate esters, acetals; and natural oils such as triglycerides including rape-seed oil, sunflower oil and the like.
15. A wellbore fluid according to any preceding claim wherein a discontinuous liquid phase such as water or a brine is added together with one or more emulsifier to form a water-in-organic-liquid emulsion wherein the discontinuous phase is present at up to 70% by volume of the emulsion.

16. A wellbore fluid as in any preceding claim wherein it further comprises a dispersion in the wellbore fluid of finely divided particles of an electrically conducting solid insoluble in the organic liquid or water.
17. A wellbore fluid as in Claim 16 wherein the finely divided electrically conducting solid is selected from the class including metals; carbon preferably in the form of graphite or carbon fibre; metal coated carbon fibre or graphite; conductive polymers such as polyaniline, polypyrrole, organometallic phthalocyanines and the like.
18. A wellbore fluid as in Claim 16 or 17 wherein the finely divided conducting solid is in the form of high aspect ratio fibres, flakes or platelets.
19. A wellbore fluid according to any preceding claim further comprising a functional wellbore fluid components such as clay, organoclay or polymeric viscosifiers; filtration reducers, weighting agents or a lubricating additive.
20. A method of drilling or completing a well wherein the wellbore fluid used is as in any preceding claim.
21. A method of providing enhanced information from electrical logging tools, measurement while drilling, logging while drilling, geosteering and the like wherein the efficiency is enhanced by the improved electrical conductivity of the wellbore fluids as in any of claims 1 to 19.

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